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PATENT SPECIFICATION

(11) 1 375 723

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H2A 2M
H2E 11 2A 2F 2Q

(72) Inventor ROY PRICE BOWCOTT

(19)

(54) DYNAMO ELECTRIC MACHINE

(71) We, JOSEPH LUCAS (INDUSTRIES) LIMITED, of Great King Street, Birmingham 19, a British Company,

declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to dynamo electric machines particularly but not exclusively starter motors for internal combustion engines.

A machine according to the invention comprises in combination a casing carrying the field assembly of the machine, a rotor shaft journalled for rotation in the casing, a rotor assembly rotatable with the rotor shaft and including the armature windings of the machine, a commutator secured to one end of the rotor shaft, the armature windings being connected to the segments of the commutator, a brush assembly carried by the casing and having brushes engaging the commutator segments, and an input terminal on the casing and electrically connected to a brush in the brush assembly, said terminal comprising a headed conductive bolt extending through an aperture in the casing with the head of the bolt within the casing and connected to said brush, the other end of the bolt being screw-threaded, insulating means spacing the shank and the head of the bolt from the casing, an insulating sleeve on the exterior of the casing and through which said bolt extends, said sleeve bearing against the casing and being held in contact with the casing by a locking washer engaging the bolt.

Preferably, said insulating means comprises a cylindrical sleeve surrounding the shank of the bolt and having an integral flange engaging the casing.

One example of the invention is illustrated in the accompanying drawings wherein:

Figure 1 is a sectional view of a starter motor,

Figure 2 is a sectional view to an enlarged scale of one of the bearings shown in Figure 1, and

Figure 3 is a sectional view of a terminal assembly shown in Figure 1.

Referring to the drawings, the starter motor includes a hollow sheet metal casing 11 which is produced by a deep drawing operation on a flat sheet of mild steel. The casing is closed at one end by an integral cover 11*a* and is closed at its other end by a die-cast end bracket 12 which carries the mounting lugs 13 of the starter motor. At its end remote from the end bracket 12 the casing 11 is deformed locally to provide internal projections 14 which serve to locate in position a moulded synthetic resin brush box 15. The brush box 15 is secured to the casing 11 by screws, conveniently self-tapping screws 16 which engage the brush box directly or engage pierced sheet metal clips engaged with the brush box. The brush box defines a first bearing 17 of the rotor shaft 18 of the starter motor. The end bracket 12 carries a second bearing 19 of the rotor shaft, and intermediate the bearings the rotor shaft carries the rotor assembly of the starter motor, including armature windings 21. Between the rotor assembly and the bearing 17 the shaft 18 carries a face commutator 22, brushes carried by the brush box 15 being spring urged into engagement with the segments of the commutator 22. The rotor shaft 18 extends through the bearing 19, and the projecting portion of the rotor shaft 18 carries a conventional pinion assembly 23 engageable, in use, with the toothed wheel of an internal combustion engine, during cranking of the engine.

Secured within the casing 11 is the field assembly of the starter motor, the field assembly including a cylindrical mild steel sleeve 24 which is located in position within the casing 11 by stops 25 integral with the casing 11. At its end remote from the stops 25 the sleeve 24 projects beyond the open

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1375723 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

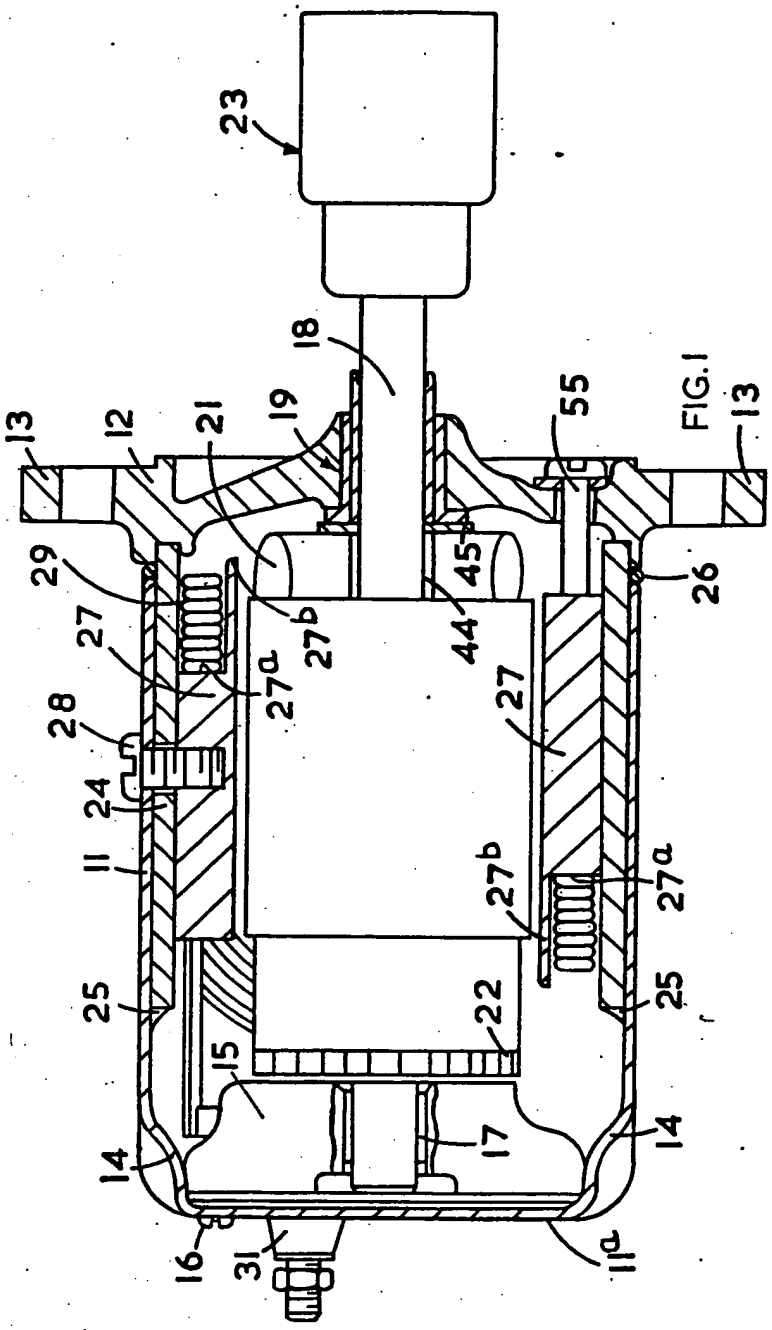

FIG.1

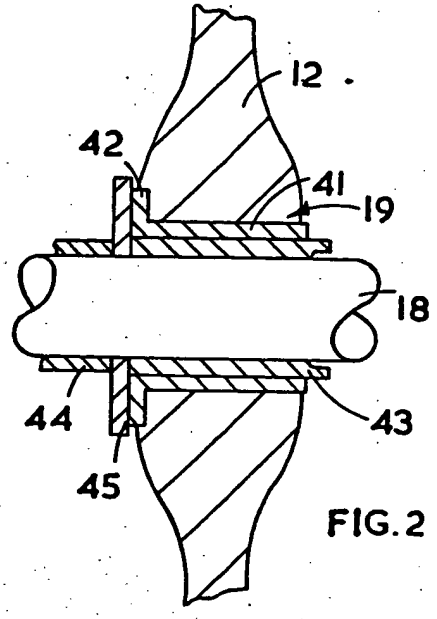

FIG. 2

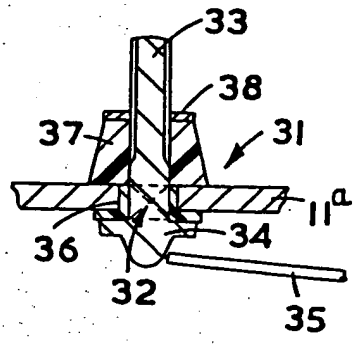

FIG. 3

end of the casing 11, and engages in a peripheral groove in the end bracket 12 a rubber sealing ring 26 being trapped between the end of the casing 11 and the end bracket 12 to seal the junction of the end bracket and the casing. Positioned within the sleeve 24 are four steel poles 27 two of which are shown in Figure 1. Figure 1 is a right angle section, rather than a 180° section, and so the two poles shown in Figure 1 are not opposite one another, but are spaced through 90° around the sleeve 24 from one another. Each pole has a rounded end 27*a* and a flange 27*b* which overlaps the rounded end 27*a*. Thus a slot is defined between the inner surface of the sleeve 24 and the flange 27*b* of each of the poles. A first pair of diametrically opposite poles is positioned within the sleeve 24 with their rounded ends towards the end bracket 12, while the other pair of diametrically opposite poles have their rounded ends towards the integral cover 11*a*. The pair of poles with their rounded ends towards the cover 11*a* are secured within the sleeve 24 by spot welding the poles to the sleeve. The other pair of poles are secured in position by pole screws (one of which is shown at 28) which extend through the casing 11 and the sleeve 24 into the poles, and which also serve to secure the sleeve 24 against rotation within the casing 11. Engaged with the poles 27 is a wave wound field winding 29 having curved portions which extend around the rounded ends of the poles 27 respectively, and axially extending portions interconnecting the curved portions, the axially extending portions being positioned between the poles. The flanges 27*b* of the poles extend along the axial sides of the poles, as well as at the rounded ends of the poles, and the flanges 27*b* trap the wave wound field winding in position against the sleeve 24. One end of the field winding 29 is electrically connected to the casing 11 by means of a copper braid hot pressed at one end to the winding and at the other end to one of the poles, the pole being provided with a zinc coating to facilitate the hot pressing operation, and the other end of the field winding is connected to a pair of diametrically opposite brushes carried by the brush box 15.

A further pair of diametrically opposite brushes carried by the brush box 15, and spaced through 90° around the axis of the commutator 22, from the brushes connected to the winding 29, are electrically connected to an input terminal 31 on the cover 11*a* of the casing.

The terminal 31 is constituted by a headed copper bolt 32 (Fig. 3) the shank 33 of which is screw-threaded. The shank 33 extends through a square aperture in the integral cover 11*a* with the head 34 of the bolt within the casing and a region of the shank of square cross section within the aperture. The head 34 of the bolt is connected by way of a conductive lead 35 to said brushes, and the shank 33 and head 34 of the bolt are insulated from the cover 11*a* by means of an insulating spacer 36. The insulating spacer 36 includes a sleeve of square cross section which extends between the wall of the aperture in the cover 11*a* and the squared region of the shank 33, and a flange integral with the sleeve which extends between the head 34 of the bolt and the inner surface of the cover 11*a*. The projecting, screw-threaded portion of the shank 33 is surrounded by a frusto-conical sleeve 37 of insulating material, the wider end of the sleeve 37 engaging the outer surface of the cover 11*a*. In order to secure the bolt 32 in position relative to the cover 11*a*, a locking washer 38 conveniently a washer of the SPIRE type is engaged with the shank 33. The locking washer 38 is passed freely along the shank 33 to engage the narrower end of the sleeve 37, and in order to lock the washer in position, the washer is deformed slightly by a punching tool to grip the shank 33 so as to prevent the washer being unscrewed from the shank 33 in normal use. It will be appreciated that since the washer is not screw threaded on to the shank then there is very little risk of the parts of the terminal being collapsed or distorted, by the engagement of the washer with the shank as could arise from overtightening of a nut. In order to make a connection to the terminal, a conventional eyelet terminal is engaged over the shank, and is trapped in position by a nut.

The bearing 19 includes a sleeve 41 engaged as a force fit in an aperture in the end bracket 12. At its inner end the sleeve 41 is provided with an integral outwardly extending peripheral flange 42, the sleeve 41 defining the outer part of the bearing 19. The inner part of the bearing 19 is defined by a sleeve 43 engaged as an interference fit with the shaft 18. Loosely mounted on the shaft 18 between the rotor assembly of the starter motor, and the flange 42, is a spacer sleeve 44 and a thrust washer 45. One end of the spacer sleeve 44 abuts against the rotor assembly, while the other end of the sleeve 44 abuts against the thrust washer 45. The thrust washer 45 in turn abuts against the flange 42, the thrust washer 45 and the flange 42 defining a thrust bearing. The dimensions of the parts are such that the shaft 18, and hence the rotor assembly, are held against axial movement in one direction by the thrust washer 45 the sleeve 44 and the flange 42. A thrust bearing (not shown) associated with the bearing 17 resists axial movement of the shaft 18 and rotor assembly in the opposite direction,

and the arrangement is such that the two thrust bearings provide a predetermined degree of freedom in an axial direction. The thrust bearing associated with the bearing 17 includes a steel washer on the shaft 18 which abuts against the brush box and an insulating, fibre washer positioned on the shaft between the steel washer and the commutator, the diameter of the steel washer being such that even if the fibre washer wears away after prolonged use, the steel washer will not bridge the commutator segments.

The end bracket 12 is secured in position relative to the casing 11 by means of screws 55 which extend through the end bracket 12 and into engagement with the poles 27 having their rounded ends towards the cover 11*a*.

It will be appreciated that the starter motor can be of the inertia type, that is to say the type where the pinion assembly is moved along the rotor shaft solely by a quick pitch thread acting between the pinion assembly and the shaft, or can be of the pre-engaged type, where the movement of the pinion assembly relative to the rotor shaft is caused, or aided, by a solenoid. It will further be appreciated that the poles 27 and field winding 29 of the field assembly could be replaced by permanent magnets.

In use, the starter motor is mounted on the frame of an internal combustion engine by means of the lugs 13 of the end bracket 12. The casing 11 is earthed through the frame of the engine. It will be appreciated that the manner in which the four poles 27 are secured in position will be governed to some extent by the assembly sequence of the starter motor. Thus the pair of poles said earlier to be spot welded to the sleeve 24 alternatively could be secured in position by screws while the other pair are spot welded in position, or all four piles could be secured by screws, or welding.

The term SPIRE used above is believed to be a Registered Trade Mark.

Attention is drawn to our copending Applications Nos. 3013/71 and 3014/71. (Serial Nos. 1,375,721 and 1,375,722).

WHAT WE CLAIM IS:—

1. A dynamo electric machine comprising in combination a casing carrying the field assembly of the machine, a rotor shaft journalled for rotation in the casing, a rotor assembly rotatable with the rotor shaft and including the armature windings of the machine, a commutator secured to the rotor shaft adjacent one end thereof the armature windings being connected to segments of the commutator, a brush box carried by the casing and having brushes engaging the commutator segments, and an input terminal on the casing and electrically connected to a brush in the brush box, said terminal comprising a headed conductive bolt extending through an aperture in the casing with the head of the bolt within the casing and connected to said brush, the other end of the bolt being screw-threaded, insulating means spacing the shank and the head of the bolt from the casing, and an insulating sleeve on the exterior of the casing and through which said bolt extends said sleeve bearing against the casing and being held in contact with the casing by a locking washer engaging the bolt.

2. A machine as claimed in Claim 1 wherein said insulating means comprises a cylindrical sleeve surrounding the shank of the bolt and having an integral flange engaging the casing.

3. A machine as claimed in Claim 1 or Claim 2 wherein the rotor shaft is journalled for rotation in the casing by a bearing the bearing including a cylindrical sleeve secured to and rotatable with the rotor shaft said sleeve constituting the inner part of said bearing, a thrust washer surrounding the rotor shaft and disposed between said sleeve and the rotor assembly, and stop means limiting movement of said thrust washer towards the rotor assembly, and said thrust washer abutting against a part fixed with respect to the casing to limit movement of said shaft in one direction.

4. A machine as claimed in Claim 3 wherein said part against which the thrust washer abuts is a flange at the end of a sleeve constituting the outer part of said bearing.

5. A machine as claimed in any one of the preceding claims wherein the casing is formed from sheet metal and includes an integral closed end core, the casing locating said brush box.

6. A machine as claimed in Claim 5 wherein the field assembly of the machine includes a cylindrical sleeve, four poles within the sleeve and a field winding carried by the poles, the cylindrical sleeve being provided within said casing between the casing and the poles and extending throughout the length of the poles.

7. A machine as claimed in any one of the preceding claims wherein the rotor shaft carries a pinion assembly and the machine is constructed to operate as a starter motor.

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